

CLAIMS

What is claimed is:

1. A five degree-of-freedom gantry positioning apparatus for a radiation imaging system, the gantry positioning apparatus adapted to connect a gantry to a support structure, comprising:
 - 5 a first linear positioner for translating a gantry in a first direction relative to the support structure;
 - a second linear positioner for translating the gantry in a second direction relative to the support structure, the second direction being orthogonal to the first direction;
 - 10 a third linear positioner for translating the gantry in a third direction relative to the support structure, the third direction being orthogonal to the first and second directions;
 - a first rotary positioner for rotating the gantry about a first axis relative to the support structure; and
 - 15 a second rotary positioner for rotating the gantry about a second axis relative to the support structure.
2. The gantry positioning apparatus of Claim 1, further comprising:
 - 20 a control system for controlling the translational and rotational movements of the gantry.
3. The gantry positioning apparatus of Claim 2, wherein the control system actuates the gantry positioning apparatus to move the gantry to a user-defined position and orientation.
4. The gantry positioning apparatus of Claim 2, wherein the control system actuates

the gantry positioning apparatus to a position and orientation based upon stored positioning data.

5. The gantry positioning apparatus of Claim 2, further comprising a position feedback mechanism for determining the position of the gantry relative to the support structure.
6. The gantry positioning apparatus of Claim 1, further comprising a gantry secured to the gantry positioning apparatus in a cantilevered fashion.
7. The gantry positioning apparatus of Claim 6, wherein the gantry is generally O-shaped.
- 10 8. The gantry positioning apparatus of Claim 6, wherein the gantry is generally C-shaped.
9. The gantry positioning apparatus of Claim 6, wherein the gantry comprises a source of radiation and a detector located opposite the source to detect projected radiation.
- 15 10. The gantry positioning apparatus of Claim 9, wherein the source comprises an x-ray source.
11. The gantry positioning apparatus of Claim 10, wherein the x-ray source and detector are rotatable around the interior of the gantry to obtain object images at various projection angles.
- 20 12. The gantry positioning apparatus of Claim 11, wherein the x-ray source and detector are operable to obtain two-dimensional x-ray images of an object.

13. The gantry positioning apparatus of Claim 11, wherein the x-ray source and detector are operable to obtain three-dimensional computerized tomographic object images.
14. The gantry positioning apparatus of Claim 1, wherein the support structure comprises at least one of a wall, a floor, and a ceiling.
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15. The gantry positioning apparatus of Claim 1, wherein the support structure comprises a cart.
16. The gantry positioning apparatus of Claim 1, wherein the support structure comprises a table for supporting an object to be imaged.
- 10 17. The gantry positioning apparatus of Claim 1, wherein the support structure is mobile.
18. The gantry positioning apparatus of Claim 1, further comprising a bracket for mounting the linear and rotary positioners.
19. An imaging apparatus comprising:
15 a generally O-shaped gantry having a radiation source and a detector operable to obtain images of an object positioned inside the gantry;
a support structure;
a gantry positioning apparatus that secures the gantry to the support structure in a cantilevered manner, the positioning apparatus translating the gantry to multiple positions in a direction that is substantially parallel to the central axis of the gantry; and
20 a processor which receives imaging data from the detector obtained at

multiple gantry positions, and combines the data to extend the field of view of the imaging system in the direction of gantry translation.

20. An imaging apparatus comprising:
 - 5 a gantry having a radiation source and a detector operable to obtain images of an object positioned inside the gantry;
 - a support structure;
 - a gantry positioning apparatus that secures the gantry to the support structure in a cantilevered manner, the positioning apparatus operable to rotate the gantry about a first axis, and translate the gantry in the directions of a second axis and a third axis, where the first, second, and third axes are mutually orthogonal; and
 - 10 a control system that actuates the gantry positioning apparatus to rotate about the first axis and translate in the directions of the second and third axes so as to approximate a rotation of the gantry about a focal spot of the radiation source.
21. The imaging apparatus of Claim 20, wherein the radiation source and detector obtain multiple images while the gantry apparatus approximates a rotation of the gantry about a focal spot of the radiation source.
22. The imaging apparatus of Claim 21, further comprising a processor which receives imaging data from the detector obtained at multiple gantry positions while the gantry apparatus approximates a rotation about a focal spot of the radiation source, and combines the data to extend the field of view of the imaging system in the direction of gantry rotation.
23. The imaging apparatus of Claim 22, wherein the object images are anterior/posterior object images.

24. The imaging apparatus of Claim 22, wherein the object images are lateral object images.
25. An imaging apparatus comprising:
 - a gantry having a radiation source and a detector operable to obtain images of an object positioned inside the gantry;
 - a support structure;
 - a gantry positioning apparatus that secures the gantry to the support structure in a cantilevered manner, the positioning apparatus operable to rotate the gantry about a first axis that is parallel to, and non-collinear with, an iso-centric axis of the gantry, the positioning apparatus further operable to translate the gantry in the directions of a second axis and a third axis, where the first, second, and third axes are mutually orthogonal; and
 - a control system that actuates the gantry positioning apparatus to rotate the gantry about the first axis and to translate the gantry in the directions of the second and third axes so as to approximate a rotation of the gantry about the iso-centric axis of the gantry.
26. The imaging apparatus of Claim 25, wherein the iso-centric axis of the gantry comprises the vertical axis.
27. An imaging apparatus comprising:
 - a gantry having an interior diameter;
 - a radiation source and a detector rotatable about the interior of the gantry to obtain images of an object positioned inside the gantry;
 - a support structure;
 - a gantry positioning apparatus that secures the gantry to the support structure in a cantilevered manner, the positioning apparatus operable to

translate the gantry in two perpendicular directions; and
a control system that actuates the gantry positioning apparatus to
translate the gantry in coordination with the rotation of the source and detector,
such that, for a rotational position of the source and detector, the detector is
5 tangent to a virtual circle centered on the and containing the object being
imaged, where the virtual circle has a diameter that is less than the interior
diameter of the gantry.

28. The imaging apparatus of Claim 27, wherein the source is an x-ray source.

29. The imaging apparatus of Claim 27, wherein the imaging system obtains two-
10 dimensional object images.

30. The imaging apparatus of Claim 27, wherein the imaging system obtains three-
dimensional computerized tomography object images.

31. The imaging apparatus of Claim 27, wherein the source and detector rotate to
multiple positions around the interior of the gantry, and at each rotational
15 position of the source and detector, the control system translates the gantry so
that the detector is tangent to the virtual circle.

32. The imaging apparatus of Claim 27, wherein the virtual circle contains a support
structure for supporting the object being imaged.

33. The imaging apparatus of Claim 32, wherein the support structure comprises a
20 table.

34. The imaging apparatus of Claim 33, wherein the object being imaged comprises
a human patient.

35. In an imaging system, a method of rotating a gantry about an iso-centric axis, comprising:
 - rotating the gantry about an axis that is parallel to and non-collinear with an iso-centric axis;
 - 5 translating the gantry a first distance in a first direction; and
 - translating the gantry a second distance in a second direction so as to maintain the iso-center of the gantry in a fixed position.
36. The method of Claim 35, wherein a gantry positioning apparatus rotates and translates the gantry.
- 10 37. The method of Claim 36, wherein the gantry positioning apparatus supports the gantry in a cantilevered fashion.
38. The method of Claim 35, wherein the iso-centric axis is the vertical axis.
39. A method of obtaining a large field-of-view in an imaging system, comprising:
 - rotating a gantry about an axis, the gantry comprising a radiation source and a detector operable to obtain image data of an object within the gantry;
 - 15 translating the gantry a first distance in a first direction; and
 - translating the gantry a second distance in a second direction so as to approximate a rotation of the gantry about a focal spot of the x-ray source;
 - obtaining image data of an object while the gantry approximates a rotation about the focal spot of the x-ray source; and
 - 20 combining the image data to produce an image with a wide field-of-view.
40. The method of Claim 39, wherein the image is an anterior/posterior image.

41. The method of Claim 39, wherein the image is a lateral image.
42. The method of Claim 39, wherein the source is an x-ray source.
43. A method of increasing the field-of-view of an imaging system, comprising:
 - 5 rotating a radiation source and a detector in the interior of the gantry to a first rotational position, the gantry containing an object to be imaged;
 - translating the gantry to a first translational position such that the detector is tangent to a virtual circle centered on and containing the object to be imaged, where the virtual circle has a diameter that is less than an interior diameter of the gantry; and
- 10 obtaining an image of the object.
44. The method of Claim 43, wherein translating the gantry comprises translating the gantry in two perpendicular directions.
45. The method of Claim 43, further comprising:
 - 15 rotating the radiation source and detector to a plurality of rotational positions within the gantry; and
 - at each rotational position, translating the gantry to a corresponding translational position such that the detector remains tangent to the virtual circle.
46. The method of Claim 45, wherein obtaining an image of the object comprises obtaining a three-dimensional computerized tomographic image of the object.
- 20 47. The method of Claim 43, wherein the source comprises an x-ray source.
48. A gantry for supporting an imaging system, said gantry being translatable in three different directions and rotatable about two different axes.